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ABSTRACT

Recent trends in science education associated with the evolution of science curriculum development centers in the Asian region are reviewed. These trends, and factors influencing them, are discussed under the following headings: science education and curriculum development centers; adaptation phase; shifts toward indigenous programs; science education, rural development, and informal education; science equipment; decentralization and dissemination; regional cooperation; and research and development. The role in promoting the trends at three centers is also discussed. The centers include Science Education Centre of the University of the Philippines and the Institute for the Promotion of Teaching Science and Technology of Thailand (examples of national centers) and the regional Centre for Science and Mathematics Education, set up as a training institution for key science education personnel throughout the region. Establishment of the centers, science education research projects, curriculum and instructional material development, science equipment, and teacher training are among the topics discussed. Major accomplishments/progress in science education in southeast Asia are summarized in a concluding section, indicating among others that in-service teaching training has formed a vital and integral part of curriculum development/implementation and is a vital cornerstone in the new programs developed. (Author/JN)

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PREFACE

This series of Occasional Papers is published by the Asian Centre of Educational Innovation for Development (ACEID), Unesco Regional Office for Education in Asia and the Pacific, as part of its effort to build up an information base in support of the Asian Programme of Educational Innovation for Development (APEID). Papers received from eminent educationists are reproduced for distribution so that their new ideas, approaches, ways of looking at education may be made widely known as a source of stimulation for further reflection and discussion.

ABOUT THE AUTHOR

The author of this paper, Dr. M.N. Maddock, is a Senior Lecturer in Education at the University of Newcastle, N.S.W., Australia, where he is involved with teaching and research in science education, curriculum development and multicultural education, with special interests in education in developing countries. Over the periods 1963–69 and 1972–73 he held various positions as science teacher, high school principal, high school inspector and superintendent with the Papua New Guinea Department of Education. He was Project Director for the UNICEF aid project for science teaching in Papua New Guinea, the first U.N. aid project in that country. In 1969–71, he worked with the Intermediate Science Curriculum Study Project at Florida State University in the United States. In 1980 he spent a year's sabbatical leave studying the work of aid agencies in assisting science curriculum development in Asia and Africa, visiting several countries in these two regions. During 1982 he has been involved in two curriculum evaluation projects for the Australian Development Assistance Bureau, one concerning education in the Pacific countries of Tonga and Western Samoa, and one concerning Papua New Guinea.

Grateful thanks are herewith expressed to him for his valuable contribution.

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SOME TRENDS IN THE EVOLUTION OF SCIENCE CURRICULUM CENTRES IN ASIA

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This paper first reviews some recent trends in science education associated with the evolution of science curriculum development centres in the Asian region and some influencing factors at work and then looks in more detail at the role in promoting these trends of three of these centres, namely, the Science Education Centre of the Philippines (UPSEC) and the Institute for the Promotion of Teaching Science and Technology of Thailand (IPST), as examples of national centres, and the Regional Centre for Science and Mathematics Education (RECSAM) which was set up as a training institution for key science education personnel throughout the region.

SCIENCE EDUCATION AND CURRICULUM DEVELOPMENT CENTRES

> *Education was a luxury in many Asian countries before 1950. Those who were fortunate to go to schools usually terminated their school education after six to nine years..... There was not much emphasis as yet in the study of science (including physics) in the secondary school of the fifties. General Science education began only in the 7th or 8th grade. In fact, physics as a separate subject was introduced into Malaysian schools in the late 1950s. (Chin Pin Seng and Tan Boon Tee, 1978, p. 38).*

Following the second world war, the countries of Asia were faced with a mammoth task in developing their education systems and in particular in introducing or updating science education. There was an implicit faith that a good science education system was a necessary precursor of economic development.

Some idea of the magnitude of the problem can be assessed from a report on the plight of India, in an ACEID publication, which highlights its vast population, limited funds and multitude of separate states, each with its own school structure, where

science and mathematics teaching in the post-independence era was mainly verbal, with a critical shortage of science and mathematics teachers, laboratories and equipment, where the teachers had not mastered modern methods and where the teacher training colleges could not cope. (ACEID, 1977A).

Although the situation in Asia is still far from idyllic, with shortages of funds, teachers, facilities and equipment still being the norm, it has shown marked improvement, passing through a series of stages of rapid development of education systems, with the initial establishment of science programmes through borrowing or adaptation of curricula first developed in western countries, to the establishment of national curriculum development centres responsible for the devising of indigenous curricula, the production of support materials and equipment, the in-service training of teachers, and for research and evaluation in science education. All the centres follow a research based development, trial evaluation and revision model along the lines of the one drawn up at the APEID Mobile Field-Operational Seminar in 1979 (APEID, 1980 - See Figure 1).

Before the 1960s, the term 'curriculum development' was not known or understood in the region. Syllabus design and textbook development were carried out in ad hoc fashion by individuals or small groups of people, as for example in the context of Sri Lanka:

> *The phrases current at that time were revision of syllabuses and revision of pupils' textbooks. National needs and goals were not considered. The general feeling was that what existed was adequate, except for a few amendments here and there. When one considers that what existed was largely London University syllabuses and outdated British textbooks, it is no exaggeration to state that curriculum development as a national need was hardly recognized during this period (ACEID, 1977 E, p. 9).*

Even in the early 1960s ad hoc committees were still in operation in some of the countries of the region, for example the Syllabus and Timetable Committee of 1956 and the General Syllabus Revision Committee of 1964 in Malaysia, where curriculum development was viewed merely as the specification of subjects to be taught and the hours of instruction per subject and the development and revision of subject syllabuses at the various levels of education (ACEID, 1977B, p. 4).

There was increasing recognition that special attention was required for science, not only as a school subject, but in a role relevant for all spheres of everyday life, as a part of everybody's

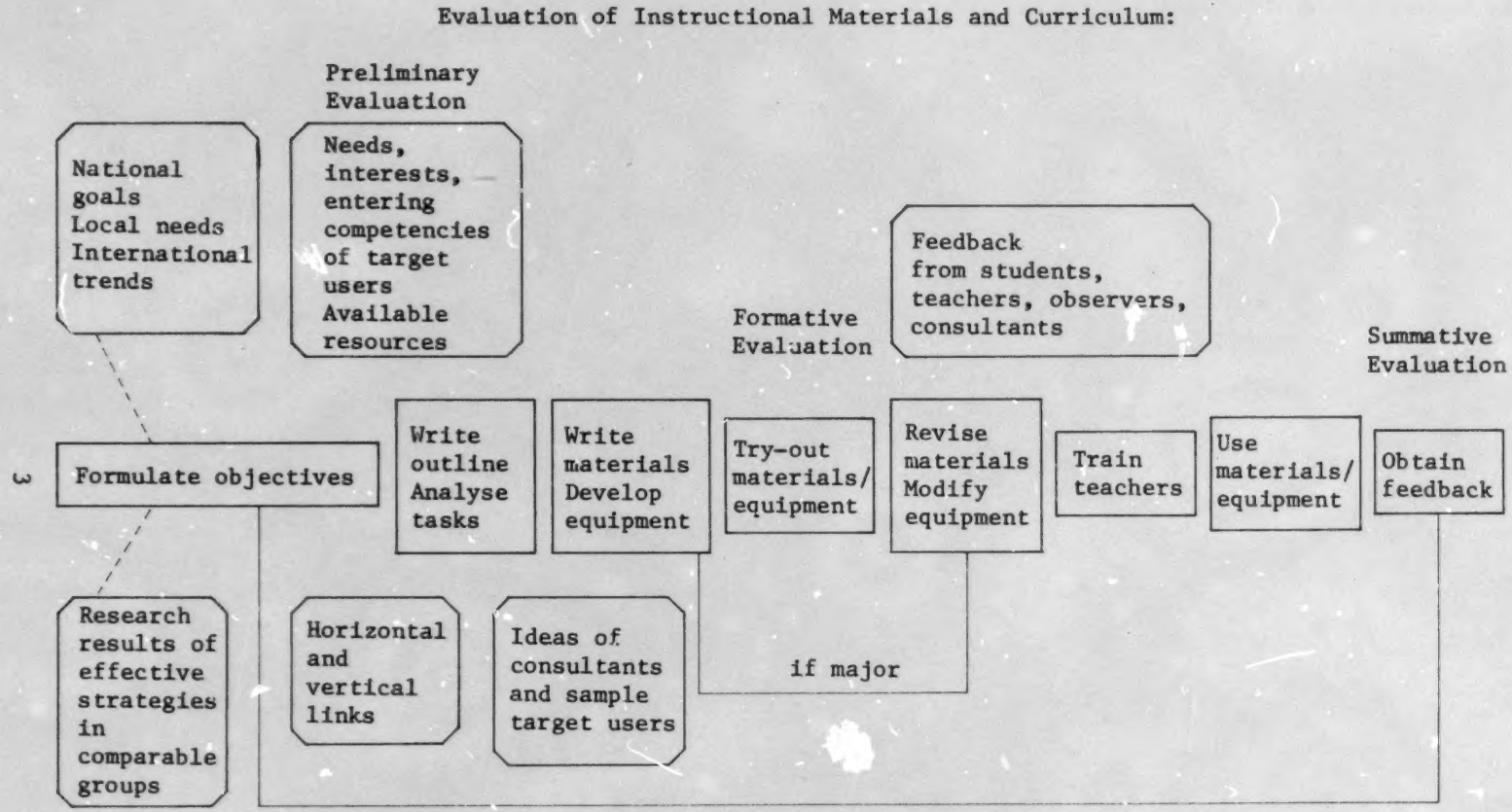


FIGURE 1 CURRICULUM DEVELOPMENT MODEL PROPOSED BY APEID MOBILE FIELD OPERATION SEMINAR IN 1979 (from APEID, 1980, p. 34).

basic education and the resulting evolution of separate national institutions for curriculum development in science is regarded as by far the most significant development in the Asian region (Bulletin of the Unesco Regional Office for Education in Asia, 1977). The Philippines was the first of the region's nations to establish a national centre specifically for science curriculum reform and their initiative was soon followed by other countries in the region. (Chin Pin Seng, 1979A).

The Curriculum Development Centre of Malaysia, the Planning and Research Division in Education and Culture in Indonesia, the Institute for Promotion of Teaching Science and Technology in Thailand, the Curriculum Development Division in Singapore, the National Bureau of Curriculum and Textbooks in Pakistan, the National Council of Educational Research and Training in India and the Science Centre in Afghanistan all represent institutions set up in response to a recognized need for indigenous curriculum development. Their institutional structures vary from country to country, from a central agency with a prescriptive role in development and implementation, to a promotional and facilitative role (ACEID, 1977E, preface), and in some cases other subjects than science come under their umbrella, but all play a major role in the development, try-out and implementation of new science and mathematics curricular endeavours.

The needs which triggered the establishment of the institutions have varied from country to country, such as the unsatisfactory nature of textbooks or a need for improved teaching methods, and their evolutionary patterns varied but, in general, they are all moving in a similar direction:

> *Whatever the original perception, the programmes of these institutions show unmistakable signs of developing towards greater comprehensiveness (as opposed to single-subject orientation), articulation (linkages between curriculum development procedures, instructional materials and evaluation systems), and greater integration with the schools, the teachers and the teacher training systems. (ACEID, 1977E, preface).*

The history and functions of the centres of India, Malaysia, Pakistan, Thailand and Sri Lanka have been well documented in a series of publications by the Asian Centre of Educational Innovation for Development (ACEID 1977A, 1977B, 1977C, 1977D, 1977E). This paper will later examine in some detail the work of the Philippine and Thailand centres, both of which operate as centralized agencies with complete responsibility for science and mathematics curriculum development and evaluation.

THE PHASE OF ADAPTATION

The initial efforts carried out in most of the countries of the region tended to be the adoption or adaptation of science curricula from overseas, western countries, dating from before the establishment of Centres and continuing into the early days of their operation. By far the most popular of these imports were the American courses BSCS, CHEM and PSSC, with BSCS being the most prominent among these, while Nuffield and Scottish projects from Britain found their way into Malaysia. A perusal of literature put out by the various American projects during the 1960s and other sources showed that BSCS, CHEM and PSSC had spread throughout the world, with BSCS having been tried on an experimental basis, adapted in some way or adopted in over 40 countries, including Afghanistan, Ceylon, India, Indonesia, Pakistan, the Philippines and Thailand. These projects brought with them the 'project' approach of writing, evaluation and revision cycles.

The best documented project was the 1964 adaptation of the Green Version of BSCS by the Philippines, various aspects of which are referenced in a number of publications, for example Science Education Centre, University of the Philippines (1968), Maybury (1975), and Villavicencio (1976). Although the project approach was applied to both the Philippine and the Thailand Yellow Version Adaptations, the extent of try-outs, evaluation and revision was somewhat limited (Chiowanich, P., and Rojanee, J., 1965, Science Education Centre, University of the Philippines, 1968). In Malaysia, the Scottish Integrated Science Syllabus, the Nuffield Secondary Science and 'O' level projects, O'level Nuffield Biology, Chemistry and Physics, the Scottish Mathematics Group materials and the English School Mathematics projects were adapted for use during the period 1967-1968. (ACEID, 1977B).

A number of factors were at work which influenced the establishment of this phase of adaptation and adoption, one of which was the anxiety on the part of the countries, once having overcome initial inertia, to obtain quick results. Throughout the 1960s, publicity was high concerning the work of the various foreign projects, and personnel associated with projects made overseas trips which could be regarded as promotional. For example, Arnold Grobman of BSCS visited the Philippines, Thailand and Ceylon (Grobman 1965A, 1965B, 1965C) and reported back to the project. There was interest and support for sending nationals overseas for study at universities in the U.S.A. and the United Kingdom. For example, the doctoral programmes carried out by Hernandez (1960) and Sangalang (1961) of the Philippines were certainly influential in launching the Philippine BSCS project.

Another major influence was the attitude of the international aid agencies, which supported and even overtly promoted adaptation, both financially and through the employment of

personnel from the projects as consultants and by assisting overseas study tours by nationals, as typified by the following statement by Unesco in a mimeographed paper on the attack on scientific literacy:

> *We should indeed be standing on the shoulders of giants such as the Physical Science Study Committee of the U.S.A., the Nuffield Foundation of the U.K., and several other such modern curriculum reform groups. In fact, it suggests strongly that one way to get started immediately is to select the best future Pilot Project participants by sending them to learn the content and spirit of the new approach to teaching by attending the Summer Institutes run by the National Science Foundation in the U.S.A. and the Nuffield Foundation in the U.K., and similar activities in other countries (Unesco, 1964).*

Unesco took the attitude that there was a high correlation between the introduction of science and technology and economic development:

> *The correlation between economic development and science and technology is so high that one definition of a less developed country is simply: a country without science and technology (Unesco, 1965).*

UNICEF, the Asia Foundation, the U.S. Agency for International Development (USAID), the Ford Foundation and Centre for Curriculum Renewal and Educational Development Overseas (CREDO) all played active roles in supporting science education in the Asian region, often taking major initiatives. For example, the Malaysian Government was approached by the Overseas Development Authority, which had already been involved in African projects, to change the Malaysian School Science Curriculum and a formalized agreement was drawn up between Malaysia and United Kingdom through CREDO to set up an administrative structure for curriculum change, using modern English science materials and British key personnel (ACEID, 1977B).

SHIFT TOWARDS INDIGENOUS PROGRAMMES

Although adaptation of foreign projects resulted in establishment of science education programmes throughout the Asian countries, the results were far from satisfactory and a major area of complaint at the Regional Workshop for Planning for Science Education in Asia held in Bangkok in 1968, which this writer attended, was the difficulties being encountered by the use of

foreign courses. Reports such as those by Brown (1959) on common features of the scene in Burma, Taiwan and Afghanistan, and by Phanuel (1966) indicate the extent of the difficulties which had to be faced in adaptation of overseas materials in countries of Asia.

The level of criticism has been continued. For example R. Villavicencio (1976) reports the considerable difficulties experienced with the Philippine BSCS adaption and similar problems were experienced with the Philippine version of CHEM study (Esguerra, 1980). Problems were experienced with the British materials in Malaysia, where it has been reported that rational reasons were not given for adoption, there was no clear delineation of national needs and the rapid change in both content and approach imposed great demands on resources (ACEID, 1977B).

As a result of this level of disenchantment, there has been a major shift in emphasis towards the development of indigenous curriculum programmes, based on the experiences gained in the earlier projects and despite the great diversity of education systems in the region there has developed a unanimity in science education policies. These policies claim that education in science and technology should not alienate a learner from cultural heritages and values; that curricula must be adapted to cultural conditions and practices and must be integrated closely with real life; that science and technology must be appropriate and in harmony with cultural concepts and values and result in a better quality of life. (Chin Pin Seng, 1979A).

When one examines new materials being produced in the region today, there is evidence that the traditional approach of science as a body of knowledge still exists to a significant degree but a shift towards developing conceptual understanding through application to real-life problems, the use of enquiry approaches, the emphasis on processes and the use of applications incorporating technology, is evident. As a legacy of the influence of the imported projects, the new programmes are being developed in package form incorporating instructional materials, equipment and in-service training for the teaching force. There is a shift towards integration and the introduction of environmental issues.

SCIENCE EDUCATION, RURAL DEVELOPMENT AND INFORMAL EDUCATION

The major trend indicated above became significantly evident in the period 1978-81, with a shift away from more academic science towards increasing emphasis on integrated rural development, the development of productive skills needed for economic development, functional education for out of school youth and adults and better health and nutrition. Considerable criticism had been levelled at

past efforts as exemplified by the following attack on the narrowly conceived education process by a prominent Asian educator writing in 1977:

> *It is confined to the book, the teacher and the school, it is cut off from the real concerns of society, whether these are the necessity to produce more or distribute better, or to solve local problems of shortages, health, housing, unemployment and so on. A child going to school and studying his books with the teacher may even get an impression that all the problems that he hears about in his family and the neighbourhood are an illusion. Education is generally formal, aloof and passive (Ahmed, 1977, p. 183).*

Rais Ahmed saw science education as being for the conquering of ignorance, rather than nature, for the benefit of mankind, based on the principles of compulsory science education from primary school onwards, reshaping the curriculum with a view to national development and with relevance to local life:

> *so that education may not have an alienating effect on the individual, dividing him from the uneducated and poor family, and pulling him away from the rural community, turning him into the unemployed and discontented youth of the towns. (Ahmed, 1977, p. 188).*

He advocated a functional approach to the problems of food, nutrition, health, sanitation and housing, with an element of work experience and the production of simple articles, which would generate funds to be ploughed back into the schools.

Although this move has not gone very far as yet, all the countries have responded positively to such criticism and are shaping in this direction through the work of their curriculum development centres. For example, J. Ratnaike (1978) reported that in Malaysia there had been several definite signals in political and other circles concerning the need to make educational efforts less academic and more directly and quickly focused on various socio-economic and cultural development needs.

In India, there has been reported widespread acceptance of the principle that environmental studies must form an important component of the first 4-5 years of education, with curriculum efforts being made to orient teachers to the principle of work experience and the development of necessary skills for utilizing techniques for improving life conditions, for example the

popularization of dry latrines, water filters, new varieties of crops and fertilizers, concepts of family planning, hygiene, child care, pollution and conservation and the promotion of the habit of scientific thinking, with the aim of students gradually introducing them into their communities (Ahmed, 1979). Students are expected to tap a local fund of traditional knowledge in medicine, medicinal plants, weather, agricultural and fishery practice, child birth and beliefs and lores, with the aim that:

> *These elements can then be subjected to the test of scientific analysis to perhaps discover the kernel of truth in this neglected store of knowledge (Ahmed, 1979, p. 3).*

A similar theme has been followed in Pakistan where the Educational Policy of 1972 stressed the urgent need to re-design curricula for a massive shift from general education to more purposeful agro-technical education, resulting in a new curriculum emphasizing work-oriented and production-oriented activities providing a cutting edge to the economy of the country (ACEID, 1977C).

One of the more successful and better documented efforts in this direction has been undertaken by the Science Education Centre at the University of the Philippines (UPSEC), following earlier concentration on discipline-based textbooks and curriculum materials, in which it is now focusing attention on the rural community, where about 70 per cent of the total Philippine population lives. Assessments of community needs and resources are being made to identify topics derived from real-life situations for development into learning units (APEID, 1980 p. 21). Aspects of these efforts will be described in more detail later in this paper, under the section devoted specifically to the activities of the centre.

The newer UPSEC endeavours are aimed at the non-formal sector and adult education, which is at last coming under focus, some 18 years since Curle (1963) first emphasized the importance of developing countries putting a significant proportion of their finance and efforts into this sector. A cornerstone of this approach is the development of 'scientific literacy' within the adult community. H.S. Bhola (1977) claims that although some success has been achieved with literacy in the social sciences, the same cannot be said for the natural sciences and urges promotion in the latter.

> *It must be said that as we talk of scientific literacy here we do not have unreasonable aspirations. We ought to give adult learners the core of scientific ideas that they could use to cope with life around them: to come to*

terms with their bodies, to understand the land they till and the animals they depend upon; to learn to harness energy to make their work less brutalizing; and to live in harmony with their environment. (Bhola, 1977, p. 235).

Bhola draws attention to the need for resources such as books and instructional materials to back up an adult scientific literacy campaign, with special attention on scientific literacy for new literates. The speed and facility with which attempts at improving ways of living, saving the environment, improving health habits, agricultural practices and production methods is seen in the Third World countries as depending on the creation of a climate of opinion favourable to scientific ideas, and on the achievement of a basic degree of 'scientific literacy' whereby a majority of people attain some understanding at least of the simpler scientific principles and their applications which contribute to development efforts (ACEID Newsletter, 1979, p. 7).

SCIENCE EQUIPMENT

Another important trend that has permeated the Asian region since the 1960s and has accelerated markedly since the establishment of the Curriculum Development Centres, has been the attention given to developing appropriate, cheap, readily available equipment to support the science programmes. In the early days of the science education revolution in the region, with emphasis on imported curricula, very little thought had been given to the capacity of the countries to buy and distribute science equipment to support the programmes. Equipment was expensive and could not be provided in sufficient quantities for effective teaching. International aid was sometimes provided (e.g. by UNICEF) to purchase overseas and import quantities of formal school laboratory equipment to service the academic practical activities in the courses. A project on the development of local equipment was supported by the Colombo Plan at the Science Education Centre, University of the Philippines in the early 1960s. The concept of linking the availability and design of equipment with the requirements of the curricula and developing the two hand in hand, did not become an integral part of the scene until the establishment of the national centres.

The model that has evolved begins with the development and pre-tryout of prototype designs. This is followed by limited production of a revised design for the pilot trials of curriculum units before the final production version is produced. This is in line with the recommendations of the 1972 regional seminar on school science equipment (Unesco, 1973), (See Figure 2) and is being followed.

Most countries in the region have established equipment units as integral parts of their curriculum development structure, frequently making use of simple locally available or recycled raw materials. For example, India, Bangladesh and Sri Lanka have had

SUGGESTION FOR
A GENERAL SYSTEM FOR THE DESIGN, PRODUCTION AND DISTRIBUTION
FOR SCHOOL SCIENCE EQUIPMENT

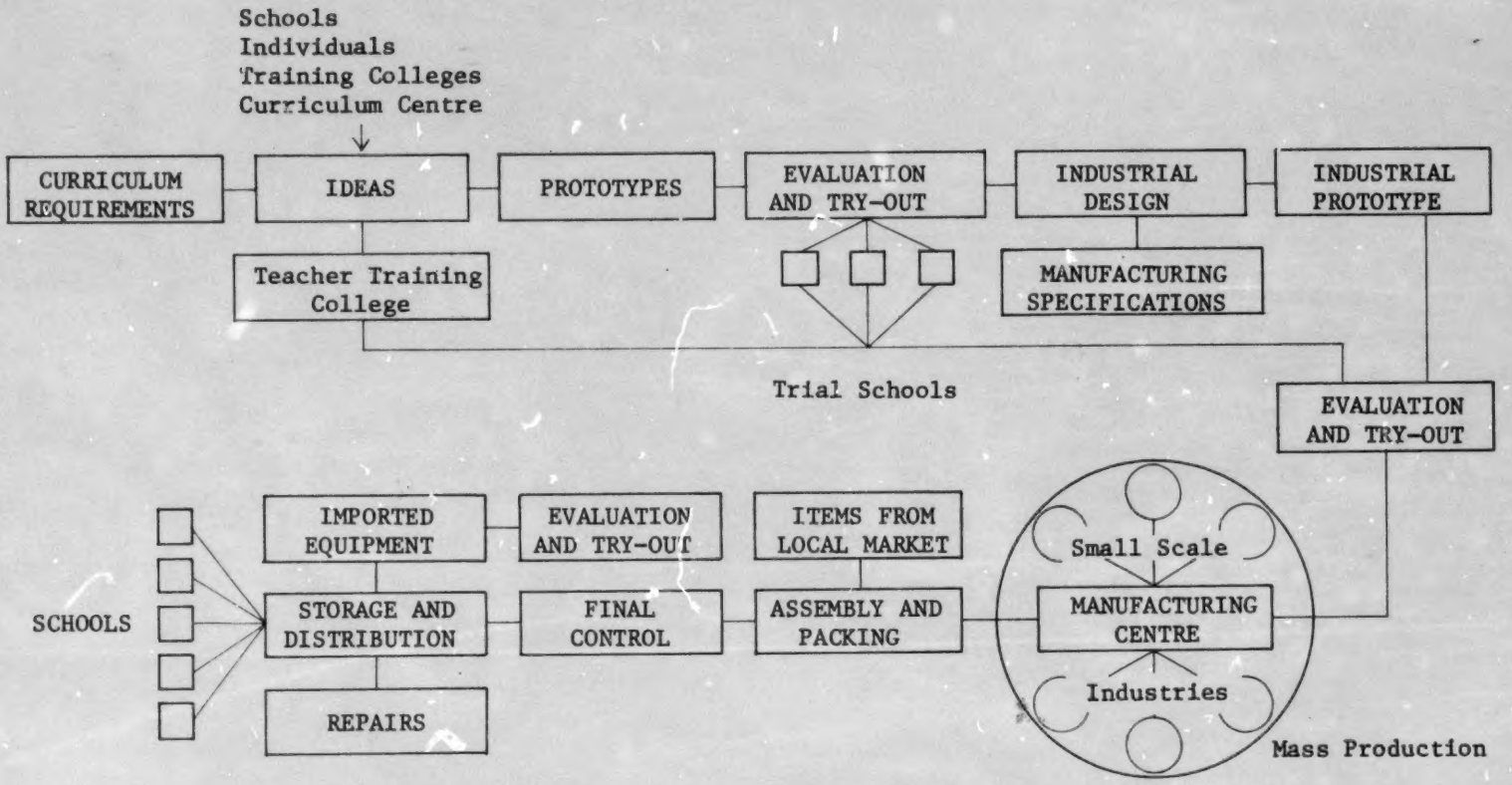


FIGURE 2 RECOMMENDED SCHEME FOR DESIGN, EVALUATION AND DISTRIBUTION OF EQUIPMENT FROM 1972 REGIONAL UNESCO SEMINAR. FIGURE FROM UNESCO (1972), CHART 1, p. 23.

well developed equipment design centres for some years (Unesco, 1973). The Central Science Workshop at NCERT, New Delhi, began working on designing equipment in 1968, concentrating on two types of kits, one for class demonstration and one for pupil experiment, and by 1977 had produced kits to cover primary and the middle years of junior high school, although the problem still facing the country at that time was enormous. (ACEID, 1977A).

Both India and Burma had moved into large-scale equipment production for national programmes by 1972. In India, the central workshop of NCERT first of all produced kits for primary and middle school levels, with further contracts having been made by UNICEF with small-scale industries to supply primary and middle school kits. Burma's University of Science Workshop attached to the Arts and Science University at Rangoon supplied equipment to most of that nation's secondary schools. (Unesco, 1973).

DECENTRALIZATION AND DISSEMINATION

A unique pattern appears to have emerged, with a highly centralized curriculum developmental process associated with a decentralized implementation process. Strong centralization is seen as being an important factor in the wise use of resources as no developing country can afford the luxury of 'laissez faire' in curriculum development as practised in industrial countries (Chin Pin Seng, 1979A, p. 12). Government authority for the centrally developed materials to become the official curriculum for the country is an essential factor in the success of the model.

In India, the system of states provides the avenue for decentralized dissemination, with the involvement of about 30 different administrative entities, half a million schools, two and a half million teachers and eighty seven million in the implementation phase. NCERT prepares units in Hindi and in English, which are then translated to regional languages by the states (ACEID, 1977A). Both the Philippines and Thailand have well established regional science teaching centres (14 in the Philippines and 15 in Thailand), while Malaysia had completed plans for similar regionalization through teacher resource centres in the various provinces from 1979, and Indonesia established 6 regional centres in 1980 (Chin Pin Seng, 1979A).

REGIONAL CO-OPERATION

Another unique feature of the Asian region is the very high level of regional co-operation operating between the countries themselves and between the countries and the Unesco Regional Office for Education and its Asian Programme for Educational Innovation for Development (APEID), which has led to a high degree of cross-fertilization of ideas and exchange of institutional and procedural models. At the ministerial level, co-operation within the Southeast Asian Ministers of Education Organization (SEAMEO) has resulted in

the establishment of the Regional Centre for Science and Mathematics Education (RECSAM) at Glugor in Penang, Malaysia, set up as a training establishment to help prepare curriculum experts to staff the new initiatives in science curriculum development in the various countries.

RECSAM has provided senior personnel from member countries with:

> *the best opportunities to study together, the common problems in indigenous education development, the diversity of their educational systems and educational practices, and the fostering of greater mutual understanding and appreciation of the efforts of their countries in improving education. At the same time, they can contribute their ideas and pool their talents, experiences and local knowledge to develop and produce prototype curriculum materials, study the success or failure of curriculum projects elsewhere, the latest trends in curriculum development in their Southeast Asian environment, their rich cultures and the limitations of their local resources (Chin Pin Seng, 1980, p. 15).*

A more detailed analysis of the RECSAM programmes will be given later in this paper.

The 1968 Regional Workshop on Planning for Science Teaching Improvement in Asian Schools, held in Bangkok for country and consultant-adviser personnel of Unesco/UNICEF-assisted projects in science education in Asia, was probably the most influential factor which set the stage for the present state of development in the region, and is still talked about amongst educators in the area and in the aid agencies as being probably the most successful effort of its kind in the Third World context, providing a model for subsequent ventures of a similar kind in other regions.

Most of the countries have tried to implement the basic strategy for curriculum reform recommended by the workshop, and one of the most significant workshop recommendations was that governments must create strong units within their ministries and departments of education, with an associated guideline to all aspects of planning:

> *co-ordination of component units which will participate in the programme; the translation and implementation of aims into teaching and learning experiences in the classroom*

(curriculum development); authorization of curriculum; preparation, production and distribution of textbooks, teachers' guides, equipment and other instructional materials; supervision of the overall plan; orientation of the administrators; pre-service and in-service programmes; follow-up, including supervision, public relations and provision of extension services; examinations and other student evaluation procedures; costs and personnel requirements. (Unesco/UNICEF 1969, pp. 3-4).

The workshop further recommended that national development centres be established, which would not only draw on research findings from all over the world but carry out research to satisfy their own needs (Unesco/UNICEF, 1969, p. 6). Subsequent support by Unesco, UNICEF and ACEID for various curriculum initiatives has helped to ensure that the basic rationale thrashed out at the workshop is now well on the way to being realized throughout the region.

The whole philosophy of developing relevance, emphasis on real-life and rural development, extension to non-formal education and the need for appropriate equipment design and production has been well disseminated by a series of Unesco and UNICEF sponsored seminars and workshops, such as the 1972 seminar in Delhi on school science equipment (Unesco, 1973), the 1976 regional meeting on trends and problems in science and technology education in Singapore (Unesco, 1976) and the 1979 regional mobile field-operational seminar staged by APEID (APEID, 1980).

This latter seminar was organized jointly by the Unesco Regional Office, through its Asian Centre of Educational Innovation for Development (ACEID), the Science Education Centre at the University of the Philippines (UPSEC) and the National Council of Educational Research and Training (NCERT) of India, emphasizing the high level of mutual co-operation existing between organizations. It was attended by participants from Afghanistan, India, Japan, Malaysia, Nepal, Philippines, Sri Lanka and Thailand, who visited the Philippines and India to focus on the development of alternative structures and methods for teacher training, particularly related to the issues of real-life, the environment, community resources and expertise and on designing and developing innovative science curriculum and related instructional materials.

The national curriculum centres, in addition to their parochial role in developing materials for their own countries, have become the focus of exchange of ideas, not only throughout the Asian region, but throughout much of the Third World. For example, overseas educators and aid agency officials from Indonesia,

Thailand, Pakistan, Rep. of Korea, Nepal, Afghanistan, Sri Lanka, Japan, Malaysia, India, Sierra Leone, Ghana, and Bangladesh, as well as from U.S.A., United Kingdom and Australia were recorded in the University of the Philippines Science Education Centre's Newsletter of December 1979 as having visited the Centre between July and December of that year. During the same period, 7 of the UPSEC staff visited other Asian centres.

RESEARCH AND EVALUATION

The 1968 Regional Workshop (Unesco/UNICEF, 1969) placed an important emphasis on the role of national centres in developing an Asian model of research and evaluation, to complement the use of research findings from elsewhere, and this objective seems to have been quite successfully implemented, with a steadily growing volume of research and evaluation studies producing results directly relevant to the countries of the area. For example, Pakistan established a Test Development and Research Sector in the Curriculum Development Wing of the Federal Ministry of Education in 1974 which embarked on a test-development programme in abilities, aptitudes and achievement (ACEID, 1977C).

Piagetian-type cognitive research has been carried out in Sri Lanka (ACEID, 1977E, pp. 47-48), the Philippines (Acuna and Villavicencio, 1980) and at RECSAM (McGrath, Tananone and Jarig, 1978). The Sri Lanka study was stimulated by the launching of the elementary Mathematics Project, and aimed at determining local parameters, rather than depending on overseas evidence. Local languages and local materials were used, (ACEID, 1977E). The Science Education Centre of the University of the Philippines (UPSEC), the Institute for Promotion of Teaching Science and Technology of Thailand (IPST) and the Regional Centre for Science and Mathematics Education (RECSAM) have strongly research-based operations for their curriculum development processes as well as conducting more basic research to back up their developmental work, which will be referred to under the sections dealing specifically with these institutions.

SCIENCE EDUCATION CENTRE, UNIVERSITY OF PHILIPPINES (UPSEC)

In 1980 UPSEC has a full-time staff of 114 people, of which 59 were academic, many of them with doctoral degrees, and a further 55 administrative and support personnel. The total budget for 1979 of 1,777,220 pesos (about 108,000 pounds) consisted of just over 616,000 pesos (about 37,540 pounds) from outside funds such as Unesco, UNICEF, EDPITAF and the National Science Development Board (NSDB), (Science Education Centre, 1979). The staff is divided into a number of functional work groups (Physics, Chemistry, Biology, Mathematics, Integrated Science) for curriculum development, and units for research and evaluation, equipment and teaching aids and production. It has grown from a small beginning

in 1964 to be an extremely productive and influential curriculum development institution.

The Centre was granted permanent, semi-autonomous status in 1969, was designated as the official national centre for science curriculum development and research, and nine Regional Science Teaching Centres were set up at tertiary institutions in various parts of the country to act as outreach, in-service training and field trial feedback centres of UPSEC activities. It was allowed to retain royalties from sales of its productions and in addition, was granted continuing support through annual grants from the National Science Development Board.

Establishment and early work

As in all the countries of Asia, the Philippines experienced severe difficulties in upgrading its education system and its programmes for science education. Writing in 1970, M.E. Kimball and M.S. Magno (1970) were very critical of a number of aspects. They described the bulk of the teaching as descriptive, fact-oriented and authoritarian, with an erratic quality of instruction, using outdated and obsolete texts, with a critical shortage of science apparatus, and severe production, supply and maintenance problems. However, the authors were praiseworthy of the establishment of the Science Education Centre and were optimistic of the promise being shown by the Philippine Science Education Project which was associated with the Centre's establishment, describing it as an exciting experiment in multiagent co-operation and co-ordination which at the date of writing had been so far, remarkably successful.

In 1958, the Philippines had already taken steps to begin the process of improvement of science education by establishing the National Committee on Science Education with the task of formulating objectives for science teaching at all levels. Writing in her doctoral thesis, the present director of UPSEC stressed the need for raising the level of interest in science in the Philippines on the assumption that science education could contribute to the solving of social problems (Hernandez, 1960) and L.F. Sangalang (1961) followed a similar theme, with improved health, rice culture and basic agricultural techniques being suggested as likely outcomes of improving courses in biology and the physical sciences. Thus, when Arnold Grobman of BSCS visited the Philippines, a favourable climate existed for science curriculum initiatives. He supplied a complete set of the U.S.A. project materials and invited D.F. Hernandez and L.F. Sangalang to visit BSCS headquarters in 1962. When they returned to the Philippines, a project to adapt the Green Version was instituted, funded by the Asia Foundation, the Rockefeller Foundation and the National Science Development Board of the Philippines, the final version being completed in 1964 and widely used throughout the country by 1968. The project

used a fairly rigorous evaluation model in the latter stages, after an early phase of a qualitiative approach (Science Education Centre, University of the Philippines, 1968).

The success of the adaptation project stimulated a Ford Foundation Project in 1964, well documented by R. Maybury (1975), to set up the Science Education Centre of the University of the Philippines, which has since become a major influence in science curriculum development throughout the region, with Dr. Dolores F. Hernandez, who had led the adaptation project, as Director. The Centre set about remedying a number of the deficiencies identified by M.E. Kimball and M.S. Magno (1970), tackling chemistry, reported by E.R. Glenn (1959) as being a major deficiency, physics and mathematics. The early chemistry and physics materials were based on CHEM Study and PSSC, and elementary-level courses were also based on American models.

In 1968 Dr. L.B. Soriano, Director of the Bureau of Public Schools, and Dr. D.F. Hernandez, Director of UPSEC, visited the Intermediate Science Curriculum Study (ISCS) project headquarters in Florida, and were impressed with the potential for an adaptation for use in the first two years of secondary school in the Philippines. In 1969 an ISCS project member conducted an orientation course at UPSEC and preliminary trials were instituted, followed by a summer writing conference, to begin the adaptation process, for try-out in 7 public and 3 private schools in 1971-72 (Perez, 1970). The ISCS version introduced a strongly individualized, self-paced, integrated approach which was new to the region, which was modified during the try-out to a 6 work-group per class format. Some of the equipment was redesigned to suit local conditions, as the country did not have the capacity to support a programme which required the large quantities of equipment called for by a fully individualized approach. The final version was released in 1975 and became the official grade 7 text. (Perez, 1980).

The work of the centre attracted considerable attention internationally and was praised by R.W. Burnett (1969), who described it as one of the most active and productive science education centres, with an evaluation programme equal to the best of those done by the curriculum projects in the U.S.A., and by J.V. De Rose (1969) who spoke highly of the early efforts in physics, chemistry and mathematics, and more recently by R. Maybury (1975, p. 161), who described it as 'one of the most valid models for emulation by science educators and government authorities elsewhere.'

Moves towards indigenous curricula

A strong feature of the work of UPSEC, arising from its early association with overseas projects and the project methodology, has been the consistency of its application of the research based

'development - evaluation - revision cycle' approach. As a result of intensive evaluation of its early adaptations, UPSEC found that their materials were proving basically unsuitable for major groups of Philippine students. For example, a 1967 project carried out to evaluate the biology adaptation found that for most students, concepts were not well grasped and their performance on the various process skills were inadequate. (Villavicencio, 1976). Similar findings were found in an evaluation of the Chemistry adaptation (Esguerra, 1980) and of the Physics course (Pabellon, 1980).

As a result of such evaluation, work on second generation texts, using simpler language and more relevant content, was begun during the 1970s. Work on the biology text began in 1973 and the try-out was carried out during the period 1974-76 (Villavicencio, 1976).

A new generation of textbooks

In the meantime, the Philippines Education Development Projects Implementing Task Force (EDPITAF) had been set up to act as a co-ordinating and implementing organization for educational improvement. An evaluation of textbooks by EDPITAF found that 67 per cent of books in use, across all subjects, were in need of revision, 33 per cent needed replacement, and that not a single book could be given a favourable endorsement (Unesco, 1977). A World Bank loan of about 2.7 million pounds was arranged to undertake a national textbook project as the main vehicle for delivering reform. UPSEC was appointed as the national Centre for Science and Mathematics Textbook Development (Hernandez, 1978) and a third generation of projects was placed on the drawing board.

Work began on the third generation chemistry text in 1976, with a more concrete approach, simplified mathematical content and use of more easily improvised equipment. The recently completed ISCS adaptation was also affected by the third generation approach. Although still used by some wealthy private schools with the financial means to afford its support system, the approach was evaluated as being unsuitable for the rural barrio schools and the equipment required too expensive and too difficult to obtain. The new replacement book 'Exploring Our Environment' incorporates more environmental science and earth science materials, and is at present in a revision cycle for reprint in 1982, evaluation in 1983 and revision in 1984 (Cortes, 1980).

The individualized, modular approach characteristic of the ISCS materials has exerted considerable influence on the work of UPSEC, and this influence can be recognized in the third generation materials, particularly in physics. Lesson objectives, self checks and mastery tests are included, with optional sequences (Pabellon, 1980).

A third generation of elementary texts of which grades 1-4 had been completed and grades 5 and 6 were at the printing stage in 1980, has also been developed. Like the secondary-level texts, these are much simpler than the early efforts, which were adaptations of American materials, and there has been a shift in emphasis away from the original process approach towards science concepts (Perez, 1980).

Since 1978 the number of textbooks produced and distributed in all school subjects, particularly in science, has more than doubled, with 7 million copies having been distributed to 125 school divisions, resulting in an improvement from a ratio of 10 students per book in 1976 to two students per book in 16 subjects in 1979. Science books for primary grades 1-4 and for grades 7 and 8 and a mathematics book for grade 9 were developed in that period (Aprieto, 1979).

Non-formal education and rural development

New directions in content and approach for science education were formulating in the early 1970s, as indicated by the Director of the Centre in her review of progress over the period 1963-73 (Hernandez, 1974). The consolidation of these directions has led to UPSEC being in the forefront of the most recent regional emphasis on 'science for real life' and the thrust to develop a level of scientific literacy within the broader community. Projects aimed at developing modular materials in both English and Pilipino for use in combined formal-non-formal education in science for rural development have been instituted (Hernandez, 1980A). This move is in keeping with new national policy directives as pronounced by the country's Minister of Education and Culture - that science education is now seen as education for improvement of the quality of life, especially among the poor and deprived sectors of rural and urban populations, with applied mathematics and science being made an integral part of mass education at both the formal and non-formal levels (Manuel, 1979).

The rationale behind these new projects closely reflects ideas expressed by both D.F. Hernandez (1960) and L.F. Sangalang (1961) in their dissertation studies and comes to grips with ministerial policy that health, nutrition, family planning, agro-technology and environmental science be integrated. The objectives are listed as being to extend the outreach of science education from home to school, enrich the home environment by involving parents in practical and meaningful science-related activities, raise the level of scientific consciousness in the community, use learning situations to encourage agricultural productivity, enrich the study of science at school, use real-life situations in teaching science and develop a curriculum adapted to a changing society and rural development (Hernandez, 1980A).

The projects commence by a research-style assessment of village needs and resources, using a wide range of survey approaches. Information obtained about the economic situation, indigenous technology, community structure, health and sanitation, human and material community resources, beliefs and practices, existing scientific knowledge in the village related to its environment, aesthetic and leisure interests, physical and social restraints and the expressed needs of the village people, is analysed to identify problems and their implications. After identifying such problems, a search is made for solutions through alternative approaches, such as the use of new materials or new technologies. Ideas are developed and tested, with village participation obtained through community seminars and the establishment of appropriate community structures. This is followed by writing of materials and development of equipment, field testing, evaluation and revision, before dissemination in an implementation phase (Hernandez, 1980A).

The first of these projects was carried out by UPSEC on the island of San Salvador in conjunction with the staff of the West Visayas State College at Iloilo (one of the regional Science Teaching Centres), the Regional Office of the Ministry of Education and Culture, and the Iloilo City Bureau of Fisheries and Aquatic Resources, funded by UNICEF. The preliminary survey identified four major areas - the needs for an improvement in fishing methods and equipment, skills in maintenance and repair of boat engines, means to tackle common children's diseases and to attack the causes of communicable diseases.

A number of modular curriculum units incorporating simple background scientific principles were developed on such topics as how to make water-sealed toilets, on use of common medicinal plants and on making potable water from solar distillation. Linked with the use of the teaching materials, the project carried out training sessions at the village, and helped form a fishing co-operative, to provide a structure within which the learning could take place. The Project is reported as being very successful, with one particularly convincing and tangible outcome being that 162 families built and continued to use water-sealed toilets and that the Barangay Council passed regulations restricting the use of the beach for sanitation purposes (Da Silva, 1979).

Another project along very similar lines has been concerned with two forest communities in Quezon Province and Laguna, where forest denudation and illegal logging are creating major environmental and social problems, where economic activities are restricted because of inadequate marketing and transport facilities and health services are inadequate. Using similar tactics to those employed on San Salvador, needs were identified and modular educational units developed by the Centre's Biology Work Group (Villavicencio, 1979).

Many of the units are produced in simple comic-book format in the Pilipino language and are placed in village reading units, where they are readily accessible to villagers of limited educational background. An example of this style of module, currently undergoing a try-out, is a unit on the dangers of parasitic intestinal worms, and associated basic hygiene and treatment with a local medicinal plant niyog-niyugan. In comic-book, picture-strip format containing simple dialogue in Tagalog, the unit tells of a mother finding her son sick, and calling in the help of the village midwife, who prescribes the niyog-niyugan treatment. It then proceeds to elaborate on the plant, its cultivation and location, the life cycle of worms and simple hygiene procedures, and finishes up with follow-up questions. In the development of such units, local village experts are used as consultants, for example a tilapea farmer for a biology unit on fish farming, and considerable care is taken through use of intensive workshop meetings which follow-up field try-outs to refine and polish the units produced.

Curriculum staff at UPSEC liase with Tilapea farmers on technical matters relating to the development of materials aimed at assisting rural development

Referring to the success of the San Salvador Project, D.F. Hernandez (1980B p. 229-30) stressed the importance of 'learning to learn' and the sharing, rather than mere acquisition of knowledge, as well as the need for new knowledge:

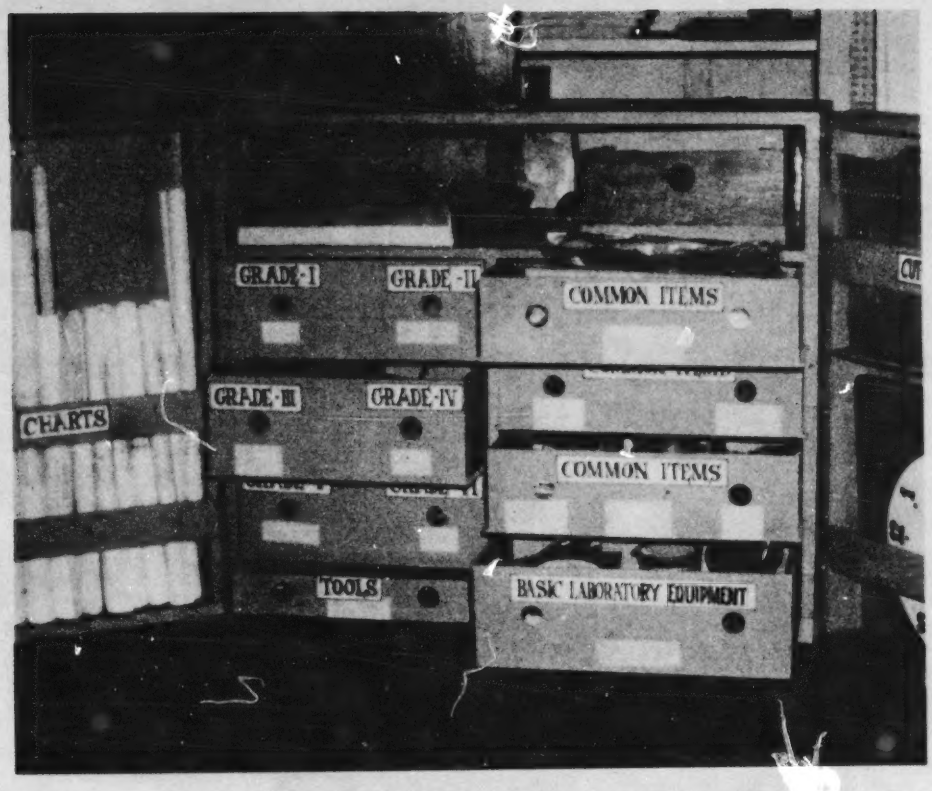
> *The San Salvador experience provides a pertinent example. The fishermen needed to know about improved ways of fishing. So they learned how to make nets; they then felt they should have pump-boats to use the nets. Since they were to be owned communally, they felt the need for an organization and this led to their request for a training programme on co-operatives.*

This epitomizes the new thrust in Asian science curriculum directions - they are not just exercises confined to a book or a classroom, or restricted only to the ideas of pure science for their own sake, they are being complexly interwoven with the social fabric of the people they serve.

Science equipment

M.E. Kimball and M.S. Magno (1970) were highly critical of equipment situation at that time and the ISCS adaptation further focused attention on the cost and logistic difficulties associated with a course which had highly specific equipment requirements. To try and overcome such problems, a School Science Equipment Project, assisted financially by the National Science Development Board and UNDP and by the expertise of the U.P. Engineering Department has been established. A well equipped workshop is located at the centre, staffed by technicians, who work in close liaison with the curriculum development teams in designing and testing equipment. Recycled materials of low or no cost are frequently used.

A cabinet containing sufficient simple and tested equipment for one class group of junior science has been developed, evaluated, and made available to schools at 400 pesos (about 24 pounds) per kit, while work is progressing on design of equipment for the new physics course. During 1979 the unit produced two kits for an electronic module, (Science Education Centre, University of the Philippines, 1979).



The elementary science equipment kit designed and built by the equipment developed project at UPSEC

Research

The Centre's approach is strongly research based, with a basic programme which

> *seeks to find out more about Filipino children, students, teachers, in relation to the teaching-learning process, and the materials of instruction. Research studies centres on sequencing, level of abstraction, relevance to pupil interest, pupil's thinking patterns, his environment and cultural values. (Science Education Centre, University of the Philippines, 1979).*

One case study, undertaken by an outsider, which has exerted an important influence on curriculum materials, was that undertaken by Paul Gardner from Monash University in Australia (1976), to identify a basic list of non-technical vocabulary, which is used as a basis for simplifying the language used in the new generation secondary materials.

As a result of the bilingual policy instituted following the Presidential Commission to Survey Philippine Education (1970), the language of instruction for the first two years of primary education is a local vernacular and thereafter English is used for mathematics and science instruction, while the national language Pilipino is used for all other subjects, with consequent special language problems.

A follow-up study has been instituted by the Centre's own personnel (Project WELS - Words in Elementary Science), aimed at determining the English language capabilities of grade 4, 5 and 6 pupils. The project has identified a list of 385 words commonly used in science and mathematics which will be used as a basis for testing and eventually to assist in the language formulation for elementary-level texts (Perez, 1980).

During 1979, the Centre embarked on a 'needs assessment' survey on environmental education aimed at identifying topics of interest and levels of interest, awareness, comprehension and responsibility, which it was hoped would produce results which can be used as indicators for future directions, leading to a core and option approach (Cortes, 1980).

The Evaluation and Research Unit at the Centre is concentrating on developing anthropological insights and on cognitive development studies. One important line being followed by the unit is the cognitive abilities of science teachers which has led to the designing of materials to help in development of subskills in abstraction and formal operations to enhance the thinking processes of elementary and secondary teachers (Acuna and Villavicencio, 1980).

As part of this approach to research, a co-operative project between UPSEC and its Regional Science Teaching Centre at Silliman University was funded by the Foundation for the Advancement of Science Education and the University Research Council of Silliman University, which investigated the development of logical thinking in biology teaching. The study led to a number of important recommendations for curriculum development and teacher training in science for the Philippines (Villavicencio and Takyo, 1981).

During 1979 the evaluation unit produced a primer on cognitive development (Science Education Centre, University of the Philippines, 1979). Research carried out in association with the

Upland Community project led to revealing important information about nutritional patterns and strategies for a nutritional education programme (Villavicencio, 1980).

Teacher training

In-service training is closely integrated with curriculum developmental work. The programme involves the training both of trial teachers for testing materials developed by the Work Groups and of those who disseminate the final versions throughout the system, closely integrated with the work of the Regional Science Teaching Centres. In 1978, teachers from the regions came to UPSEC in Manila for initial training. In succeeding summers, graduates from this programme carried out the training at the regional centres, supported by UPSEC personnel who travelled to the regions. The programme has been supported by funds from The National Science Development Board and resulted in a total of 6,475 teachers being trained in the period 1971-78 (Magno, 1979).

Another programme in which UPSEC participates which has done much to improve the qualifications and quality of Philippine teachers is the Master of Arts in Science Teaching course, conducted in conjunction with De La Salle University, in which teachers from the regions possessing a first degree come to Manila on a NSDB scholarship for an 18-month training course. Two days per week are spent at UPSEC on science subjects and the remainder at the sister institution doing education courses, followed by production of a thesis. In the period 1971-78, over 300 such scholarships were provided (Magno, 1979). The vacancies left in the regions while the teachers are in training are filled by Peace Corps Volunteers.

Apart from its commitment to formalized in-service training, the centre is also involved in less formalized avenues through the organization of, and the participation of, its personnel in a wide range of seminar and workshop activities involving Philippine and international educators. For example, during 1979, a national seminar workshop on designing and developing innovative science and technology curricula, organized in collaboration with the Ministry of Education and Culture and ACEID, a physics teachers workshop, in association with the Philippine Associations of Physics Instructors and Physics Teachers and Unesco, and a seminar on elementary mathematics sponsored by the Mathematics Teachers Association of the Philippines were conducted at UPSEC at the national level (Science Education Centre, University of the Philippines, 1979), while the Mobile Field Operational Seminar on Science and Technology Education, sponsored by Unesco for educators in the Asian region carried out its Philippine stage through UPSEC (APEID, 1980).

Unfortunately, the centre has not yet been closely involved with the pre-service teacher training programmes. It would appear to be important that new teachers entering the service for the first time should be prepared for the materials they will be expected to teach.

Areas of difficulty

The advances made by UPSEC in producing new science materials in simpler language, with more appropriate and relevant content for the wider Philippine population, have been very significant, and have played a major role in the total development of science education in the Philippines, as described by M.N. Maddock (1981), but there is still criticism at the regional rural level that the centre is too remote from, and that the developers in Manila still have a lot to learn about, the real problems of rural pupils. At least one Regional Centre is developing and testing materials of its own which it considers more appropriate than those produced by UPSEC.

There is still a great gap between the ideas of what the centre does and the realities of implementation of its ideas in the population at large. There are vast contrasts between individual schools, such as that between wealthy, private church-supported schools in parts of metropolitan Manila, which can have palatial facilities and top quality teaching staff, and the rural, self-help, non-profit barrio high schools which use vacant rooms in elementary schools, shops or other buildings to conduct their classes, with absolute minimal facilities and equipment as described by P.T. Orata (1972). In Manila there are schools with huge enrolments, such as one visited by the author in 1980 which had an enrolment of about 6,000 students attending in three shifts (morning, afternoon and evening) in a discarded town hall, the rooms of which had never been designed for classrooms.

Many of the improvements made at the curriculum development level cannot be adequately implemented because money and logistical back-up systems are insufficient to produce and deliver enough of the newly designed, cheaper equipment and materials to enough schools, or to keep up with the demand for new school buildings in areas of greatest need. In the case of the newer non-formal materials, the preliminary projects have been particularly successful, but there must be appropriate follow-up to implement the approach on a wider scale if major advances are to be made towards improvement of the quality of life for the rural poor.

THE INSTITUTE FOR THE PROMOTION OF TEACHING SCIENCE AND TECHNOLOGY (IPST) THAILAND

Establishment and structure

It was established by co-operative action of the Royal Thai Government, UNDP and Unesco in 1972 as a semi-autonomous body within the Ministry of Education. Interest was first stimulated during 1958-62 through participation in the Karachi Plan and was strengthened in the period 1964-70, when Thai educators participated in the Unesco Pilot Project for Chemistry Teaching in Asia, which brought science educators from throughout the region into working contact with innovative ideas and practices in chemistry education (ACEID, 1977D).

There was thus a favourable climate and nucleus of personnel available when a Unesco Programme Advisory Group made a report in 1969 which resulted in a request by the government to UNDP for a six-year project. The centre became operational in 1971, following a cabinet decision in 1970 for a UNDP-funded two-year preliminary phase and moved into a second funded phase from 1973-76. Several personnel from the Unesco Pilot Project for Chemistry were appointed to the new venture. (ACEID, 1977D). The Centre now has a staff of over 200 full and part-time members and, like UPSEC, is divided into a number of work groups, which the centre calls design teams, as well as five service teams for research and evaluation, equipment design and production, school service, educational innovation and documentation (IPST, information pamphlet, undated).

The international consultant component of the staffing of the project was reduced quickly and by 1973 only the Chief Technical Adviser and the Administrative Officer remained as permanent members. During the first two years, senior national staff were sent on short study tours abroad, while others were upgraded locally with the help of short-term Unesco experts (APEID, 1977D). As a result, the Institute was able to very quickly establish its own national flavour and began establishing a strong reputation:

> *anyone searching for a good Asian model for curriculum development and implementation need go no further than the Institute for the Promotion of Teaching Science and Technology (IPST) in Bangkok. Their procedure is very thorough and they have produced materials of good quality (Edwards, 1977, p. 215).*

During the period 1971-1975, UNDP had spent about 0.7 million pounds and the Thai government about 0.8 million pounds in financing running costs of the institution while the government, through agencies such as the Department of General Education and

the Teacher Training Department contributed considerable funds to bring the total Thai contribution to about 1.5 million pounds (ACEID, 1977D).

As has been done with other national centres, regionalization has been instituted to help with provincial try-outs and implementation of IPST projects. A proposal was put to UNDP for assistance to establish 36 Teacher Training Colleges, one for each two of the 72 provinces in the country. In 1979 six centres were designated, one each in the north, south and north-east, with three in the central plains. Twelve more were planned for 1980 and a further 18 in 1981 (Nida Sapianchai, 1980).

The stated objectives of the institution are similar to those of other Curriculum Development Centres in the region:

1. To initiate, execute and promote the study and research of curricula, teaching techniques and evaluation in sciences, mathematics and technology at all educational levels;

2. To promote and execute training programmes for teachers, instructors, lecturers, students and university students on the teaching of sciences, mathematics and technology;

3. To promote and execute research, development and production of science equipment and materials for teaching the sciences, mathematics and technology;

4. To promote and execute the preparation of tests, exercises, references, supplementary materials and teachers' guides on the sciences, mathematics and technology. (ACEID, 1977D).

Curriculum development efforts

By the time IPST was established, the era of direct adoption or adaptation of overseas projects had about reached a peak level of disenchantment, and the curriculum efforts of IPST started off with a much less adaptation-orientation than earlier ventures in the region. However, although as in other Asian countries, early approaches to science had been traditional, the influence of the new courses, which had reached the country through the Unesco Pilot Project in Chemistry and BSCS was strong. The Institute personnel started their efforts by making intensive studies of materials available from other countries. Study tours were undertaken in several countries including U.S.A., Philippines and Australia, and curriculum materials from the best projects were collected and studied (Nida Sapianchai, 1980).

Content was classified into two major areas, 'universal' and 'local'. For areas designated as 'universal', material was borrowed from elsewhere; but for areas designated 'local', materials were developed from scratch by the local design team (Pisarn Soydhurum, 1980). 'Universals' such as chemical bonding, periodicity, electrostatics and energy were adapted from proven texts. However, the science in such areas as ecosystems, population growth, urban growth, diet and nutrition, and in provision of examples such as chemical industry and the physics of rice mills, was drawn from Thailand. (Srithanyaratana, Sapianchai and Aylward, 1977).

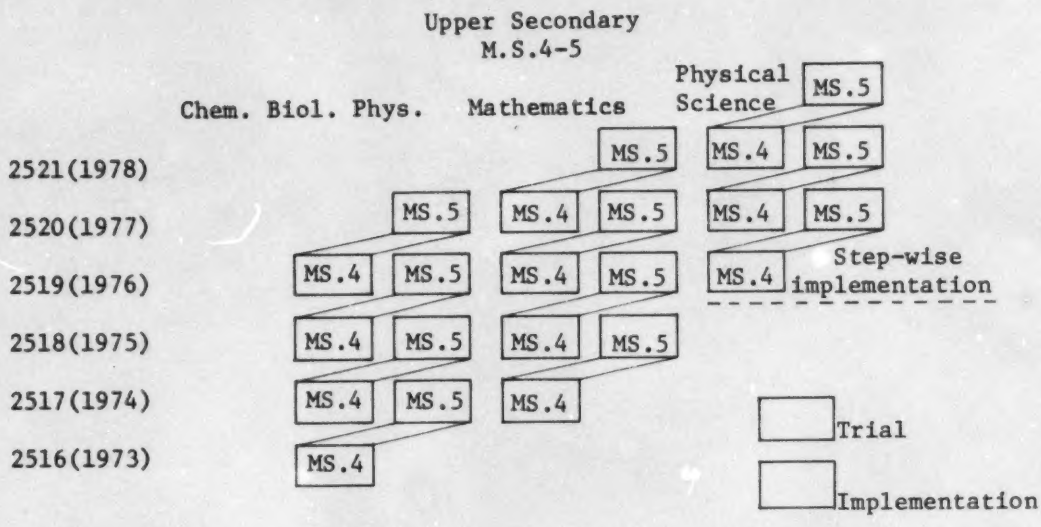
At upper secondary levels (designated M4 and M5) the new physics, chemistry and biology courses for grades 11-12 evolved from courses introduced from the developing countries in the mid 1960s and were designed as in-depth, discipline-oriented, conceptually planned courses. The parallel inter-disciplinary physical science course was developed in modular form, with alternative topics centred on science relevant to an educated citizen, while the M1-3, (grades 8-10) science course was developed as an integrated programme based first of all on the 'world around us', then on energy concepts and finally the environment in Thailand. The mathematics course was built on a blend of the 'old and the new', including the structure of mathematics but a balance of arithmetical and algebraic skills. (Srithanyaratana, Sapianchai and Aylward, 1977).

As in the other national centres, a research-based integrated approach with built-in trials and revision cycles was applied, with four concurrent areas of development - writing of student texts and teachers' guides, evaluation, teacher training and development of equipment. In the first year of operation, the upper secondary science courses were completed and all three were tried out concurrently in the same classes in 1973, using 30 teachers and 720 students. Then followed a systematic development, step-wise try-out and implementation programme in which the whole science and mathematics curriculum was revised, involving 5,500 trial students during the period 1973-75. This programme is best illustrated by Figure 3, which diagrammatically sets out the schedule of try-outs and implementation, taken from the ACEID (1977D) monograph on IPST (pp. 18-19).

Second generation curriculum development

As in other countries, a certain amount of dissatisfaction has arisen concerning the appropriateness and success of the first generation materials, particularly in vocational training areas such as agriculture, industrial arts and home economics, and it is to these areas that IPST is turning its attention as its operations move into the 1980s. Selection of content for such courses is to be based on an analysis of the vocational subjects, with integration and relevance receiving strong emphasis. (Nida Sapianchai, 1979).

IPST Trial and Implementation Plan



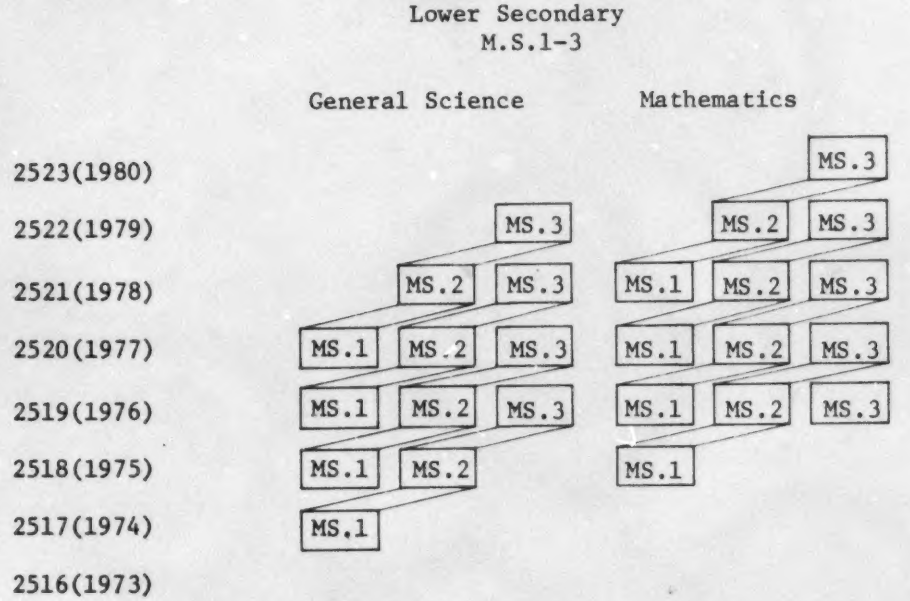


FIGURE 3 IPST CURRICULUM DEVELOPMENT STRATEGY 1973-1978, (from ACEID, 1977D)

Science curriculum materials for these vocational courses were being developed and tried out during the period 1978-80, for 1981 implementation. The science course for home economics students was being used in about 60 Government schools during 1980 (Sobhi Wonthonglour, 1980). Modules such as Medicine and Life, and Synthetic Materials were being included in the course.

Another new curriculum direction has started arising from a decision by the Ministry, in keeping with an Asia-wide trend, to integrate science, health and social science into a course concerned with 'life experiences' at elementary school level. The new project got under way in 1978. Trial versions were completed for grades 1 and 2 in 1979, with the aim of implementation in 1981, with trials for grade 6 level scheduled for 1982. (Nida Sapianchai, 1980). The project aims to put more emphasis on process skills (Yupa Tanticharoen, 1979).

The procedure adopted involves a collection of data on teachers' problems and needs, the analysis of the objectives and content of primary science related to life experiences in countries such as Japan, Philippines, India, United Kingdom, and U.S.A., the holding of workshops to arrive at science content themes suitable for the psychological development of their elementary school children and to develop the materials. Forty three schools in Bangkok and neighbouring provinces were being used for the try-outs. (Yupa Tanticharoen, 1979).

Equipment

The development of equipment is a very strongly developed facet of the operation of IPST. The equipment workshop was established in 1971 using basic machinery pruchased by Unesco from UNDP funds and in part by the Government from the IPST budget and by 1977, 80 per cent of equipment for the new curricula was being made in Thailand compared with nine per cent in the past. The United Nations Industrial Development Organization (UNIDO) funded a production engineer to set up a sound working structure (Srithanyaratana, Sapianchai and Aylward, 1977).

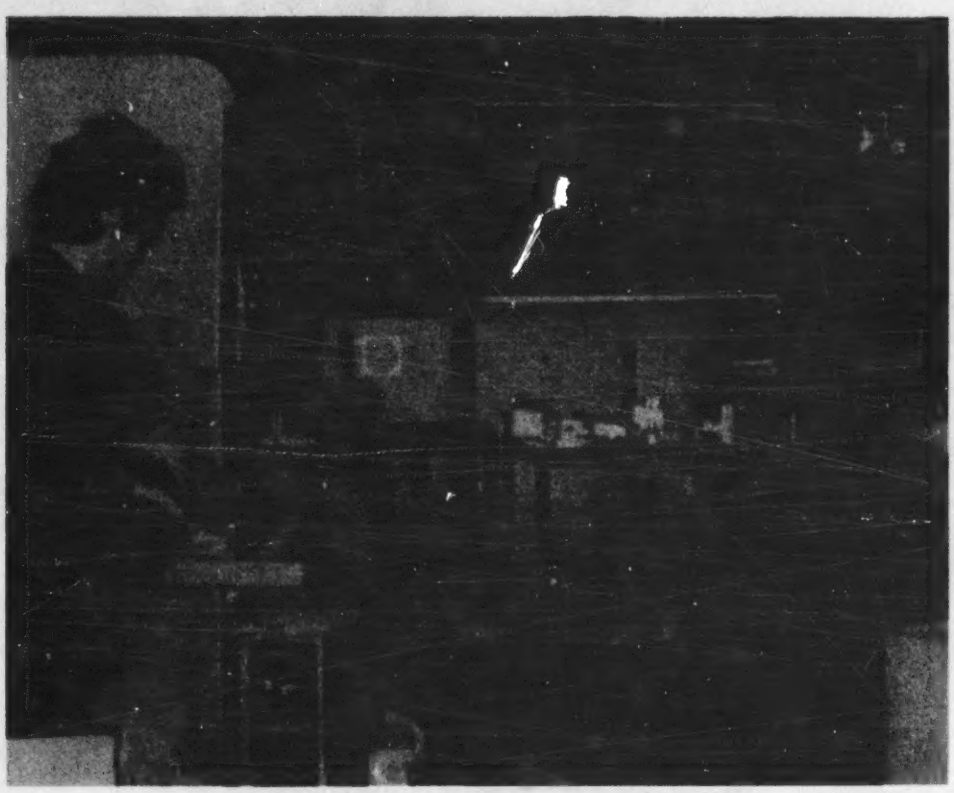
Emphasis is on simplicity, cheapness, ready availability and on the use of recycled materials. Two excellent examples of the simplicity of the equipment observed by this writer are a small, robust, simply used microscope, which was developed firstly as a 'water-drop' prototype, revised to a second prototype using a glass bead and has gone into manufacture as a 'glass bead' microscope, and a small, simple plastic electrolysis of water apparatus which is being produced in sufficient quantities for

A simple model, battery operated and geared tractor, designed and built at IPST

several groups per class (Sapianchai, 1980). Other interesting items developed by the unit include a model windmill with piston pump, model tractor with gearing, a solar dryer, a quick fertillizer test kit, a solar cooker and an alcohol-using spark-plug firing demonstration cylinder.

As design teams develop experiments for testing, rough sketches of proposed equipment are sent to the workshop for construction. The prototype constructions are tested by the design teams and eventually refined to a form which can be produced in sufficient quantity (usually about 300 pieces) for use in the school trials. In the initial MS4 senior science units, classes

were usually divided into about 15 groups of 3 pupils each, although there were some modifications to this basic formula as trials proceeded. After two years of trials for these courses, a finalized list of equipment was produced for large scale production for the nation wide implementation (ACEID, 1977D).



IPST technicians at work in the equipment production workshop

The total cost for a classroom set for the equipment for the physics course implemented in 1976 was about 18,000 baht for grade 11 and 11,000 baht for grade 12 (about 391-239 pounds), representing about 25-80 baht (0.5-2.7 pounds) per pupil. For chemistry the equivalent figure was 45 baht (about 0.98 pounds) per pupil, for biology, with 10 microscopes per class, 70 baht (1.5 pounds) and for general science 25 baht (0.5 pounds). The total value of equipment distributed by IPST in the first round of curriculum development was 2.84 million baht (about 0.6 million pounds), (ACEID, 1977D).

Research

IPST has been very active in research related to its projects, but one major difficulty for people outside Thailand is that most of the research reports have been written in the Thai language and they has not had the time or resources to arrange for translation into English to facilitate wider dissemination of findings. The ACEID (1977D, p. 68) account of the activities of the institute lists the titles of 12 research reports completed up to that time, including analyses of tests and examinations, attitude studies, and various comparative studies. IPST staff has also guided research projects of higher degree students at Srinakharinwirot University, as well as providing seminar courses on curriculum research for Ph.D. students.

The most unique feature of the institute's research strategy has been the doctoral fellowship programme for its senior personnel. The scheme provided a series of UNDP-Unesco fellowships which sent personnel who were committed to IPST and demonstrated potential for advanced studies, selected by the Director and an advisory committee, to universities in the U.S.A. and Australia for doctoral programmes. The fellowships included the granting of Unesco consultancies to the overseas doctoral supervisors and funding a visit to Thailand to consult on the research programmes chosen and the appointment of a faculty member from a Thai university or research establishment as a co-supervisor with provision for travel to the overseas university to assist the supervision there with guidance and direction of the doctoral fellow (Sapianchai and Aylward, 1976).

The programme involved about two years' study at the overseas university, during which a research proposal for a project in Thailand related to the work of IPST was drafted, and then a return to Thailand for data collection before again spending a period at the University for writing up and the examination of the thesis. The first cycle began in 1973 with seven students (Sapianchai and Aylward, 1976).

Through Monash University in Australia, a project on cognitive preference of IPST physics course students and another project in the physical science area were undertaken. From the U.S.A. projects were carried out through the University of Maryland, on the topic of classroom verbal behaviour of teachers using the new IPST Chemistry Curriculum and on the mathematical abilities of Thai students, through the University of Indiana on an educational psychology project and on earth science programmes suitable for IPST integrated science, and through the University of Texas (Austin) on classroom activities and attitudes in IPST biology. (Sapianchai and Aylward, 1976).

The doctoral fellows began to return to IPST in 1976, and it is reported that by the end of that year, the value of curriculum development research generated had become evident (ACEID, 1977D).

The second cycle of four to five more doctoral fellowships commenced in 1975.

Teacher training

As at UPSEC, in-service training forms an integral part of the strategy for curriculum development at IPST, with an approach that integrates content with method, the in-service instructors using methodologies which, it is hoped, that teachers will use in their classrooms. By 1975 the in-service programme had extended to 13 regional centres established in teacher training institutions in various parts of the country. By 1977, 90 per cent of Government school teachers had been given their first in-service courses, although there was disappointment at the response by the private schools (ACEID, 1977D), and by 1980, a total of 30,000 teachers had been through the in-service scheme (Nida Sapianchai, 1980).

The early in-service instruction team consisted of IPST design team members together with teachers from trial schools, but this policy appeared to have broken down somewhat with the extension to the regional centre system. Concern was expressed that the regional instructors have not been involved in curriculum development in the same way as the earlier teams, and there has been a loss of regional centre instructors after training by IPST. (ACEID, 1977D).

A wide range of approaches is used in the in-service programme, including the use of audio-visual presentations developed at IPST, including narrated film strips and video tapes. UNDP funds have been used to supply the regional centres with the necessary equipment for use of these aids in their programmes.

THE SEAMEO REGIONAL CENTRE FOR SCIENCE AND MATHEMATICS EDUCATION (RECSAM)

Role and establishment

The Regional Centre for Science and Mathematics Education was set up in 1967 at Glugor in Penang, Malaysia, under the auspices of the Southeast Asian Ministers of Education Organization, to help member countries to improve the teaching of science and mathematics:

> *in order to lay the foundations for meeting the technically and scientifically trained manpower requirements of the region for national development. (RECSAM, The first ten years, p. 5).*

Unlike UPSEC and IPST, its major role is not that of curriculum development in a national context per se, but one of training regional personnel for curriculum development and innovation. The developmental work of the centre arises out of integration with its training activities. It thus plays a major role in helping to prepare people with sufficient expertise to staff the national centres and participate in their programmes, with an important bi-product of providing curriculum materials of value to the region. In the words of its Director, Chin Pin Seng (1980, p. 15):

> *Most developing countries have relied too heavily on outside experts to produce suitable curriculum materials through adoption of curriculum projects developed in the country of such experts. The results have been disappointing because such materials were written for the needs of developed countries.*

RECSAM provides opportunities for Southeast Asian educators to study their common problems together and receive training in the techniques of curriculum development and evaluation.

The South East Asian Ministers of Education Organization was established in 1965 and at Kuala Lumpur in 1966, delegates to the organization's technical workshop set up a feasability study which recommended that RECSAM be launched on the site of an existing science-mathematics teachers college at Glugor. A steering committee drew up a comprehensive five year development plan for development of a new campus and hostel adjacent to the temporary site, at an estimated cost of about 1.2 million pounds, which was approved by the Fourth Ministerial Meeting of SEAMEO in Jakarta in 1969. (RECSAM, The first ten years).

Within the first eighteen months 198 educators from 8 countries had passed through the centre, and in a short interim period of just over 3 years had already acted as a catalyst for reforms in science curriculum and had made an impact on regional science education development (RECSAM, The first ten years, p. 12). By 1975, 919 participants from Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam and Hong Kong had passed through 73 short-term courses since the programme commenced in 1968. Courses covered such areas as strategies for science and mathematics curriculum development in the region, evaluative techniques, and equipment design.

The permanent phase of its operations began in 1970, with a budget of about 3.5 million pounds and in 1972, operations began on the permanent site, which is well provided with teaching, production, library and residential facilites, including a conference hall, 11 laboratories, 2 workshops and 4 residential

halls with associated dining and recreational provisions. The library houses a very comprehensive collection of general educational, science and mathematics materials, and carries out clearing house functions, having established an information network with over 200 institutions in SEAMEO member countries. It maintains significant links with institutions such as UPSEC, IPST and the other curriculum centres of Southeast Asia. Operational costs for the period 1980-85 were estimated at about 1.7 million pounds, with a further 0.7 million pounds to be allocated from special funds (RECSAM, 1980).

In keeping with its object of international co-operation, staff has been drawn from a wide spectrum. Up to 1976, staff had come from Australia, Canada, Cambodia, Denmark, France, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, Thailand, United Kingdom and the U.S.A. (RECSAM, The first ten years). This international perspective has been maintained since.

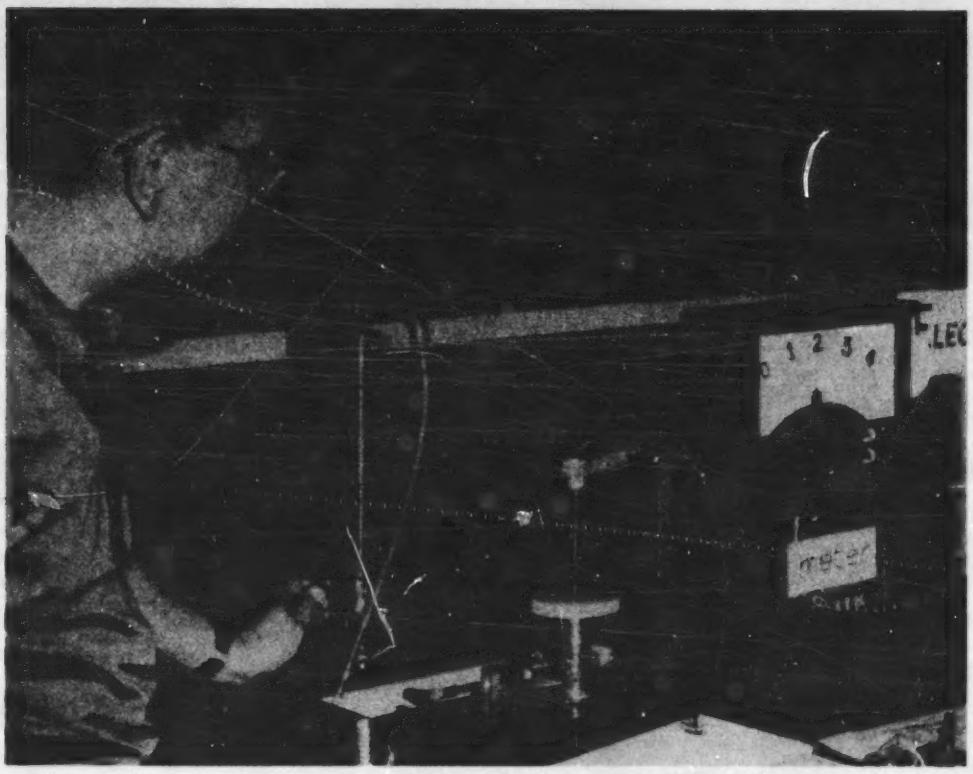
Training activities

During the period 1968-79, RECSAM had run 90 leadership courses of two and a half months duration each for over 1,900 senior level personnel in various areas of curriculum development in science and mathematics. (Chin Pin Seng, 1979B). The 1980-85 plan sets down 20 ten week courses and a maximum of two seminars, conferences or workshops per year, as well as 10 personnel exchanges of about 14 days duration each, during each fiscal year of the plan's operation. (RECSAM, 1980).

The courses proposed include approaches to classroom testing, innovative techniques in various science discipline areas, laboratory management, equipment design and production and research approaches for concept learning. Seminars and conference type activities scheduled include a workshop on evaluation techniques, a workshop on concept research, a seminar on socio-economic aspects of the impact of science and technology education in Southeast Asia, a workshop on maximizing the functional value of learning and a workshop on approaches to developing self-learning materials. (RECSAM, 1980).

The RECSAM 5 year plan (RECSAM, 1980) provides a good planning model by setting out very clearly the nature, rationale, objectives and expected outcomes of the various courses proposed. For example, the course on innovative methods of primary science and mathematics evaluation, scheduled for one 10 week session each during the second, fourth and fifth fiscal years of the plan, plans to expose participants to techniques of educational measurement, to expose them to the basic concepts of designing curricula evaluation instruments, to equip them with data collection, organization, analysis and interpretation skills, and with skills for instrument development. The course is geared towards develop-

ment of a set of tangible evaluation instruments in one particular area, and by the end of the course it is expected that participants will have acquired knowledge, skills and techniques related to the objectives, developed at least one instrument and tried out the instrument, collected and analysed data and revised the instrument. (RECSAM, 1980, pp. 12-13).



A RECSAM staff member demonstrates the working of a simple DC generator made from a plastic pill bottle, ball-point pen inset and toy motor, designed and built at the Centre

A major feature of the RECSAM course is the involvement of the participants in this kind of practical activity of a highly relevant kind, which results in the production of concrete curriculum materials output immediately usable in the participants own country or in the region in general. Examples of very tangible outcomes of the various courses on equipment design can be seen in the collection at RECSAM of various items designed and tested by participants, including a model electric generator driven by water power incorporating such mundane recycled materials as a plastic

bottle and the inset of a ball-point pen, and a model demonstrating the helicoptor principle contrived from metal scraps and a motor from a cheap toy car.

The SEASAME Project

The Southeast Asia Science and Mathematics Experiment for primary level (SEASAME) is a major project by the centre which has resulted from the integration of the training and curriculum development functions of RECSAM. The project is a research based, systems oriented, science-mathematics correlation project, which was launched in 1973, aimed at teaching science by doing, involving science and mathematics as part of cultural heritage, helping children understand how simple concepts can be applied to improve the quality of life, and assisting pupils develop and apply process skills for dealing with everyday problems and ways of dealing with phenomena in terms of interacting facets in a rapidly changing, science oriented world. The approach incorporates a 'work orientation' relevant to rural and urban community development and content areas are drawn from existing curricula in SEAMEO countries (Chin Pin Seng, 1980).

The project provides "on-the-job" training for the SEAMEO member country participants taking part in RECSAM courses linked the project. Prototype instructional and evaluation materials produced by course members are tried out and evaluated each year in selected urban and rural schools in member countries (Tan Boon Tee, 1979). Since 1975, countries continuing to try-out the project materials have been the Philippines, Singapore and Thailand (Cruz, 1978).

In 1977 as a result of diagnosis of a need for in-service training for teachers using SEASAME units, the centre ran a course on in-service techniques in which a Manual of In-service Orientation for SEASAME was produced (Chin Pin Seng, 1980). Thus the integration of the training with curriculum development resulted in a combination of trained expertise with readily usable materials available for upgrading science and mathematics education in a number of countries.

Research

In keeping with the regional philosophy of promotion of basic research in association with curriculum development, RECSAM has also produced some significant research results as an outcome associated with training courses, as exemplified by the studies carried out on childrens' conception of shadows, by participants in the RP-S1/M1 course Studies in Concept learning - Primary Science and Mathematics. They applied Piaget's clinical methods in 1978 in trials in Penang, followed up with trials in Indonesia, Malaysia, Singapore and Thailand and the 1979 equivalent course in

addition followed up with further trials in Penang. A number of curriculum recommendations resulted from the findings. (Sia, 1980). The Centre's Concept Learning Project, launched in 1973, of which this research is part, has as its goals to find out how children in Southeast Asia learn mathematical and scientific concepts and to develop sample learning sequences based on the thinking levels of children in the region. The project started out by using books by Piaget as a source of experimental procedures for the design, modification and field testing of clinical approach techniques in many countries of the region (McGrath, Tananone and Jarig, 1978).

The intention from the beginning was not only to replicate Piaget's work in the South East Asian setting but to consider the curriculum implications of the theory. Later work focused on the use of child development theory for analysing curriculum topics. In 1977 Shayer, of the Chelsea Concepts in Secondary Mathematics and Science Project (CSMS) in the United Kingdom led a Concept Learning Course in which the course participants developed a group of tasks on 'Speed of Movement' and 'Volume and Heaviness' in English and Bahasa Malay, had them tried out in Penang, translated them into the participants' own languages and then tried out them in their own countries. The try-outs in Indonesia, Malaysia, the Philippines and Singapore indicated that the method showed potential for use of the group methods for both development and evaluation of curricula in the area and identified a number of problems to be tackled by participants in courses of subsequent years. (McGrath, Tananone and Jarig, 1978).

Journal of Science and Mathematics Education in Southeast Asia

Another venture launched by RECSAM which has potential for strengthening approaches to science and mathematics education in Asia, for exchange of information within the region and for disseminating the results of curriculum research and evaluation more widely throughout the world, is the Journal of Science and Mathematics Education in Southeast Asia, launched in 1978. The journal, now in its fourth year of operation, has carried articles on projects in various parts of the region, research findings, curriculum techniques and regional trends and issues.

CONCLUSION

It is obvious from the published literature and to anyone who has visited Southeast Asia at intervals since the early 1960s, that considerable progress has been made in the area of science education. The qualifications and expertise of educators have been strongly upgraded and the establishment of national centres for development, evaluation and research in the area of curriculum has enabled such expertise to find avenues for positive expression, as well as providing legislative support for implementation of new curricula developed.

The adaptive phases passed through in the early stages, although often producing somewhat unsuitable materials for the students, provided training grounds and experiences for the first science educators, which have had long-term positive effects. These projects brought with them a strong legacy of a research based approach involving preliminary fact-finding surveying of the field, followed by development-try-out-evaluation and revision cycles, which has been firmly embraced and provides a significant framework for purposeful and systematic curriculum development. There has been a marked upsurge in more basic research related to curriculum areas being carried out by Asians in an indigenous context, which is contributing significantly to the world store of knowledge, as well as to the local scene.

The establishment of the national curriculum development centres in the various countries and the regional centre (RECSAM) in Penang, together with the promotional role played by Unesco and APEID, has resulted in an interacting network of common purpose institutions and organizations and a level of regional co-operation in educational matters that is probably unparalleled elsewhere in the Third World, or even elsewhere. Despite many cultural, political and administrative differences, there is a significant common sense of purpose and underlying rationale throughout the area. The concept of in-service teacher training forming a vital and integral part of curriculum development and implementation, which the original overseas projects promoted and which, unfortunately, is still too often ignored in the Western World, has survived in Asia to become a cornerstone in the new programmes developed.

Strong moves have been made away from the traditional, 'discipline' and 'knowledge' approaches of the past towards an emphasis on science for 'real-life' employing work-oriented situations. Attempts are now being made in earnest to move the teaching of science in a direction which has much stronger potential for fulfilling a role as a key agent for rural development and improvement of the quality of life, than past efforts have had. Emphasis is also shifting to include much more attention to adult and non-formal education. At the same time, however, new strains and demands have been placed on the teacher:

> *The entirely passive social role of 'knowledge' (equated to education) in the old system is replaced by an active role where the very purpose of studying a process or phenomenon is to control it, and harness in the interests of social development - a study of the needs and aspirations of people, in the new concept of education, must lead to a way of resolving the problems; social change and*

> *programme must become a commitment and even a passion for the learner. This makes the teacher and the school an agent of change and development in our society, and it involves intimate co-operation with other developmental agencies working in the given regions. (Ahmed, 1977, p. 184).*

Despite the impact of in-service training, there are vast numbers of teachers still to be reached and passive or negative attitudes overcome, such as those referred to in some of the key institutions in India, where kits produced by the NCERT teams remain unwrapped and not used (ACEID, 1977A). To carry the new philosophy from the curriculum development centres and their try-out schools to the country at large still requires retraining of teachers and pre-service teacher training on a massive scale. In a community-based science and technology based education as envisaged by this new philosophy, the role of the teachers is an extremely vital one, as recognized by the regional meeting in Singapore in 1976 (Unesco, 1976, p. 26). As pointed out by Ahmed (1977, p. 192) science graduates, brought up in a split-disciplined and formalized atmosphere, who are not aware of the rural scene and its problems, will not be able to handle classes in schools without re-orientation.

That teachers are worried about their ever-increasing burden of responsibility is indicated by the study on the tasks and skills required for teachers in national development (National Research and Development Centre for Teacher Education, 1977), which found that the increasing extent of involvement of teachers in socio-economic development efforts demands a diversification of the teachers' tasks and activities which detach them from the classroom and move them into the wider domain of the community. The study revealed that:-

> *although these activities, in some instances, help to enrich and reinforce the curriculum learnings of pupils, the classroom teachers feel that they are overloaded and their involvement in various development projects takes out time and effort that otherwise could be devoted to their normal school work (National Research and Development Centre for Teacher Education, 1977, p. 39)*

The underlying optimism is still based on the assumption that curriculum change and in-service training are the key, but there are much wider dimensions to be considered than these. The qualifications and experience needed by curriculum development personnel have been considerably broadened, as pointed out by J. Ratnaike (1978). Real-life situations have a host of 'discipline'

content interacting in a simultaneous and integrated manner, requiring the input of a variety of different discipline expertise, the management of which is seen by J. Ratnaike as a serious consideration. Content experts are unlikely to have any knowledge of the real-life situations of importance in raising the quality of life of the poor and in general, indigenous practices have been subjected to little study. Sociological content is less likely to be available. It is in the area of these problems where the Philippine rural development projects for non-formal education have made a start by broadening the base of their curriculum teams to bring in the indigenous practioners as key consultants.

However, there are even more difficult issues which impinge on the socio-political structure and the domain of vested interest groups which must be tackled concurrently if the recent curriculum efforts are to bear fruit.

> *To what extent can real problem solving be undertaken as a component of general education, by learners, if these problems deal with more than the symptoms to causes of poverty - such as exploitation, inegalitarian policies and practices, corruption. To what extent would a society that has given birth to poverty, sustained it over the years, and specified a status quo transmission function to the education system, permit challenges to its very existence? (Ratnaike, 1978, p. 6).*

The curriculum development centres and their embracing of modern project methods and more relevant rationales for science education have made a major step forward. However, the realities of the situation in the communities at large are still frightening in their extent. The gap between the rich and poor in the countries of Asia is still a very wide one and there are vast inequalities between metropolitan and rural situations, as found for example between the schools of metropolitan Manila and the barrio self-help schools, and between the wealthy private schools and many less endowed government schools in the urban areas of Manila, in the Philippines.

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The Asian Programme of Educational Innovation for Development (APEID) has as its primary goal to contribute to the building of national capabilities for undertaking educational innovations linked to the problems of national development, thereby improving the quality of life of the people in the Member States.

All projects and activities within the framework of APEID are designed, developed and implemented co-operatively by the participating Member States through over one hundred national centres which they have associated for this purpose with APEID.

The 21 countries in Asia and the Pacific participating in APEID are: Afghanistan, Australia, Bangladesh, China, India, Indonesia, Iran, Japan, Lao People's Democratic Republic, Malaysia, Maldives, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Singapore, Socialist Republic of Viet Nam, Sri Lanka and Thailand.

Each country has set up a National Development Group (NDG) to identify and support educational innovations for development within the country and facilitate exchange between countries.

The Asian Centre of Educational Innovation for Development (ACEID), an integral part of the Unesco Regional Office for Education in Asia and the Pacific in Bangkok, co-ordinates the activities under APEID and assists the Associated Centres (AC) in carrying them out.

The eight programme areas under which the APEID activities are organized during the third cycle (1982-1986) are:

1. Universalization of education: access to education at first level by both formal and non-formal means;
2. Education for promotion of scientific and technological competence and creativity;
3. Education and work;
4. Education and rural development;
5. Education and urban development;
6. Educational technology with stress on mass media and low-cost instructional materials;
7. Professional support services and training of educational personnel;
8. Co-operative studies, reflections and research related to educational development and future orientations.